

Application No. 10/605,408
Technology Center 2813
Submission Accompanying RCE under 37 CFR §1.114

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

Claim 1 (Currently amended): A method of forming a strained silicon-on-insulator structure, ~~structure (10)~~, the method comprising the steps of:

forming a silicon layer ~~(12)~~ on a strain-inducing layer ~~(22)~~ so as to form a multilayer structure, ~~structure (18)~~, the strain-inducing layer ~~(22)~~ having a different lattice constant than silicon so that the silicon layer ~~(12)~~ is strained during the forming step as a result of a lattice mismatch with the strain-inducing layer, and then ~~layer (22)~~;

bonding the multilayer structure ~~(18)~~ to a substrate, the bonding step being chosen from the group consisting of directly bonding a first insulating layer on and contacting the strained silicon layer of the multilayer substrate to a second insulating layer on the substrate, directly bonding an insulating layer on and contacting the strained silicon layer of the multilayer substrate to a semiconductor layer of the substrate, and directly bonding a first semiconductor layer of the substrate to a second semiconductor layer of the multilayer

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substrate and separated from the strained silicon layer by an insulating layer,
the bonding step resulting in the presence of an insulating region (24) so that
an insulating layer (14) is between the strained silicon layer ~~(12)~~ and the
substrate, substrate (24), the strained silicon layer ~~(12)~~ directly contacting the
insulating region; ~~layer (14);~~ and then

removing the strain-inducing layer ~~(22)~~ to expose a surface of the
strained silicon layer ~~(12)~~ and to yield a strained silicon-on-insulator structure
~~(10)~~ comprising the substrate, substrate (24), the insulating region, ~~layer (14)~~
~~on the substrate (24),~~ and the strained silicon layer ~~(12)~~ on the insulating
region. ~~layer (14).~~

Claim 2 (Currently amended): A method according to claim 1,
wherein the substrate ~~(24)~~ is formed of a semiconductor material.

Claim 3 (Currently amended): A method according to claim 1,
wherein the strain-inducing layer ~~(22)~~ is formed of a SiGe alloy, and the
strained silicon layer ~~(12)~~ is under tensile strain.

Claim 4 (Currently amended): A method according to claim 1,
wherein the strained silicon layer ~~(12)~~ is formed by epitaxial growth on the
strain-inducing layer. ~~layer (22).~~

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Claim 5 (Currently amended): A method according to claim 1,
wherein the removing step comprises preferentially etching the strain-inducing layer with hydrogen peroxide, hydrofluoric acid, and acetic acid. ~~the insulating layer (14) is on the substrate (22), and the bonding step comprises bonding the insulating layer (14) of the substrate (22) to the strained silicon layer (12) of the multilayer structure (18).~~

Claim 6 (Currently amended): A method according to claim 1,
wherein the bonding step comprises directly bonding the first insulating layer on the strained silicon layer of the multilayer substrate to the second insulating layer on the substrate. ~~the insulating layer (14b) is on the substrate (22), the multilayer structure (16) comprises the strain-inducing layer (22), the strained silicon layer (12) on and contacting the strain-inducing layer (22), and a second insulating layer (14a) on the strained silicon layer (12), and the bonding step comprises bonding the insulating layer (14b) of the substrate (22) to the second insulating layer (14a) of the multilayer structure (18).~~

Claim 7 (Currently amended): A method according to claim 1,
wherein the bonding step comprises directly bonding the insulating layer on and contacting the strained silicon layer of the multilayer substrate to the semiconductor layer of the substrate. ~~the multilayer structure (18) comprises~~

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~~the strain-inducing layer (22), the strained silicon layer (12) on and contacting the strain-inducing layer (22), and the insulating layer (14) on the strained silicon layer (12), and the bonding step comprises bonding the insulating layer (14) of the multilayer structure (18) to the substrate (22).~~

Claim 8 (Currently amended): A method according to claim 1, wherein the bonding step comprises directly bonding the first semiconductor layer of the substrate to the second semiconductor layer of the multilayer substrate and separated from the strained silicon layer by the insulating layer. ~~the multilayer structure (18) comprises the strain-inducing layer (22), the strained silicon layer (12) on and contacting the strain-inducing layer (22), the insulating layer (14) on the strained silicon layer (12), and a semiconductor layer (24a) on the insulating layer (14), and the bonding step comprises bonding the semiconductor layer (24a) of the multilayer structure (18) to the substrate (24b).~~

Claim 9 (Currently amended): A method according to claim 8, wherein the substrate ~~(24)~~ is formed of a semiconductor material.

Claim 10 (Currently amended): A method according to claim 1, wherein the strain-inducing layer is formed of a SiGe alloy and the removing

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step comprises preferentially etching the strain-inducing layer with hydrogen peroxide, hydrofluoric acid, and acetic acid. ~~one or more techniques chosen from the group consisting of chemical-mechanical polishing, wafer cleaving, and chemical etching selective to silicon.~~

Claim 11 (Currently amended): A method according to claim 1, further comprising the step of forming an IC device ~~(40,50)~~ in the surface of the strained silicon layer. ~~layer (12).~~

Claim 12 (Currently amended): A method according to claim 11, wherein the step of forming the IC device ~~(40,50)~~ comprises the steps of forming source and drain regions ~~(26,28)~~ in the surface of the strained silicon layer ~~(12)~~ so that the strained silicon layer ~~(12)~~ defines a channel ~~(30)~~ between the source region ~~(26,28)~~ and the drain region. ~~region (26,28), the channel (30) being in direct contact with the insulating layer.~~ ~~layer (14).~~

Claim 13 (Currently amended): A method of forming a MOSFET device. ~~device (40,50),~~ the method comprising the steps of:

epitaxially growing a silicon layer ~~(12)~~ on a SiGe layer ~~(22)~~ so as to form a multilayer structure. ~~structure (18),~~ the SiGe layer ~~(22)~~ having a different lattice constant than silicon so that the silicon layer ~~(12)~~ is under

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tensile strain as a result of a lattice mismatch with the SiGe layer; and then ~~layer (22);~~

bonding the multilayer structure ~~(18)~~ to a substrate ~~(20)~~ comprising a semiconductor layer, the bonding step being chosen from the group consisting of directly bonding a first insulating layer on the strained silicon layer of the multilayer substrate to a second insulating layer on the semiconductor layer of the substrate, directly bonding an insulating layer on the strained silicon layer of the multilayer substrate to the semiconductor layer of the substrate, and directly bonding the semiconductor layer of the substrate to a second semiconductor layer of the multilayer substrate and separated from the strained silicon layer by an insulating layer, ~~layer (24),~~ the bonding step resulting in the presence of an insulating region ~~layer (14)~~ between the strained silicon layer ~~(12)~~ and the semiconductor layer of the substrate, substrate (20), the strained silicon layer ~~(12)~~ directly contacting the insulating region; and then ~~layer (14);~~

removing the SiGe layer ~~(22)~~ to expose a surface of the strained silicon layer ~~(12)~~ and to yield a strained silicon-on-insulator structure ~~(10)~~ comprising the semiconductor layer, ~~substrate (20),~~ the insulating region, layer (14) on the substrate (20), and the strained silicon layer ~~(12)~~ on the insulating region; ~~layer (14);~~ and then

forming an IC device ~~(40,50)~~ in the surface of the strained silicon

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layer. ~~layer (12).~~

Claim 14 (Currently amended): A method according to claim 13, wherein the removing step comprises preferentially etching the SiGe layer with hydrogen peroxide, hydrofluoric acid, and acetic acid. ~~the substrate (20) comprises the insulating layer (14) and the semiconductor layer (22), and the bonding step comprises bonding the insulating layer (14) of the substrate (20) to the strained silicon layer (12) of the multilayer structure (18).~~

Claim 15 (Currently amended): A method according to claim 13, wherein the bonding step comprises directly bonding the first insulating layer on the strained silicon layer of the multilayer substrate to the second insulating layer on the semiconductor layer of the substrate. ~~the substrate (20) comprises the insulating layer (14b) and the semiconductor layer (22), the multilayer structure (18) comprises the SiGe layer (22), the strained silicon layer (12) on and contacting the SiGe layer (22), and a second insulating layer (14a) on the strained silicon layer (12), and the bonding step comprises bonding the insulating layer (14b) of the substrate (20) to the second insulating layer (14a) of the multilayer structure (18).~~

Claim 16 (Currently amended): A method according to claim 13,

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wherein the bonding step comprises directly bonding then insulating layer on the strained silicon layer of the multilayer substrate to the semiconductor layer of the substrate. ~~the multilayer structure (18) comprises the SiGe layer (22); the strained silicon layer (12) on and contacting the SiGe layer (22); and the insulating layer (14) on the strained silicon layer (12); and the bonding step comprises bonding the insulating layer (14) of the multilayer structure (18) to the semiconductor layer (22) of the substrate (20).~~

Claim 17 (Currently amended): A method according to claim 13, wherein the bonding step comprises directly bonding the semiconductor layer of the substrate to the second semiconductor layer of the multilayer substrate and separated from the strained silicon layer by the insulating layer. ~~the multilayer structure (18) comprises the SiGe layer (22); the strained silicon layer (12) on and contacting the SiGe layer (22); the insulating layer (14) on the strained silicon layer (12); and a second semiconductor layer (24a) on the insulating layer (14); and the bonding step comprises bonding the semiconductor layer (24b) of the substrate (20) to the second semiconductor layer (24a) of the multilayer structure (18).~~

Claim 18 (Original): A method according to claim 13, wherein the removing step comprises one or more techniques chosen from the group

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consisting of chemical-mechanical polishing, wafer cleaving, and chemical etching selective to silicon.

Claim 19 (Currently amended): A method according to claim 13, wherein the step of forming the IC device ~~(40,50)~~ comprises forming source and drain regions ~~(26,28)~~ in the surface of the strained silicon layer ~~(12)~~ so that the strained silicon layer ~~(12)~~ defines a channel ~~(30)~~ between the source region ~~(26,28)~~ and the drain region, ~~region (26,28)~~, the channel ~~(30)~~ being in direct contact with the insulating region, ~~layer (14)~~.

Claim 20 (Currently amended): A method according to claim 19, further comprising the step of using the semiconductor layer ~~(22)~~ to form a gate electrode ~~(36)~~ separated from the channel ~~(30)~~ by the insulating region, ~~layer (14)~~.

Claim 21 (Currently amended): A method according to claim 19, further comprising the steps of forming a gate oxide ~~(32)~~ on the surface of the strained silicon layer, ~~layer (12)~~, and forming a gate electrode ~~(34)~~ on the gate oxide, ~~oxide (32)~~.

Claim 22 (Currently amended): A method according to claim 19,

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further comprising the steps of:

using the semiconductor layer ~~(22)~~ to form a first gate electrode
~~(36)~~ separated from the channel ~~(30)~~ by the insulating region; ~~layer (14);~~
forming a gate oxide ~~(32)~~ on the surface of the strained silicon layer;
and layer (12); and
forming a second gate electrode ~~(34)~~ on the gate oxide; ~~oxide (32);~~
wherein the method yields a double-gate MOSFET; ~~MOSFET (50).~~

Claim 23 (Currently amended): A method according to claim 13,
wherein the SiGe layer ~~(22)~~ is formed of a SiGe alloy having the lattice
constant of about 0.2 to about 2 percent larger than the lattice constant of
silicon.